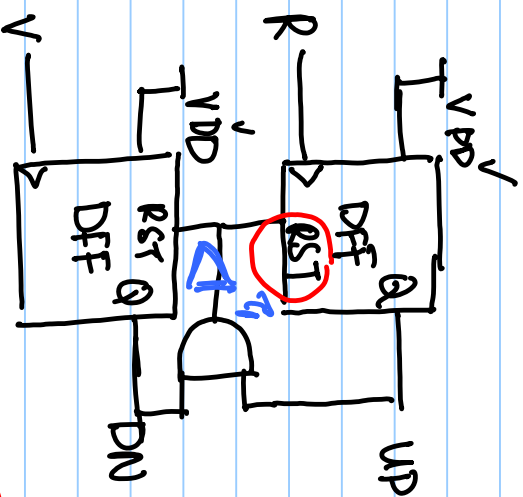


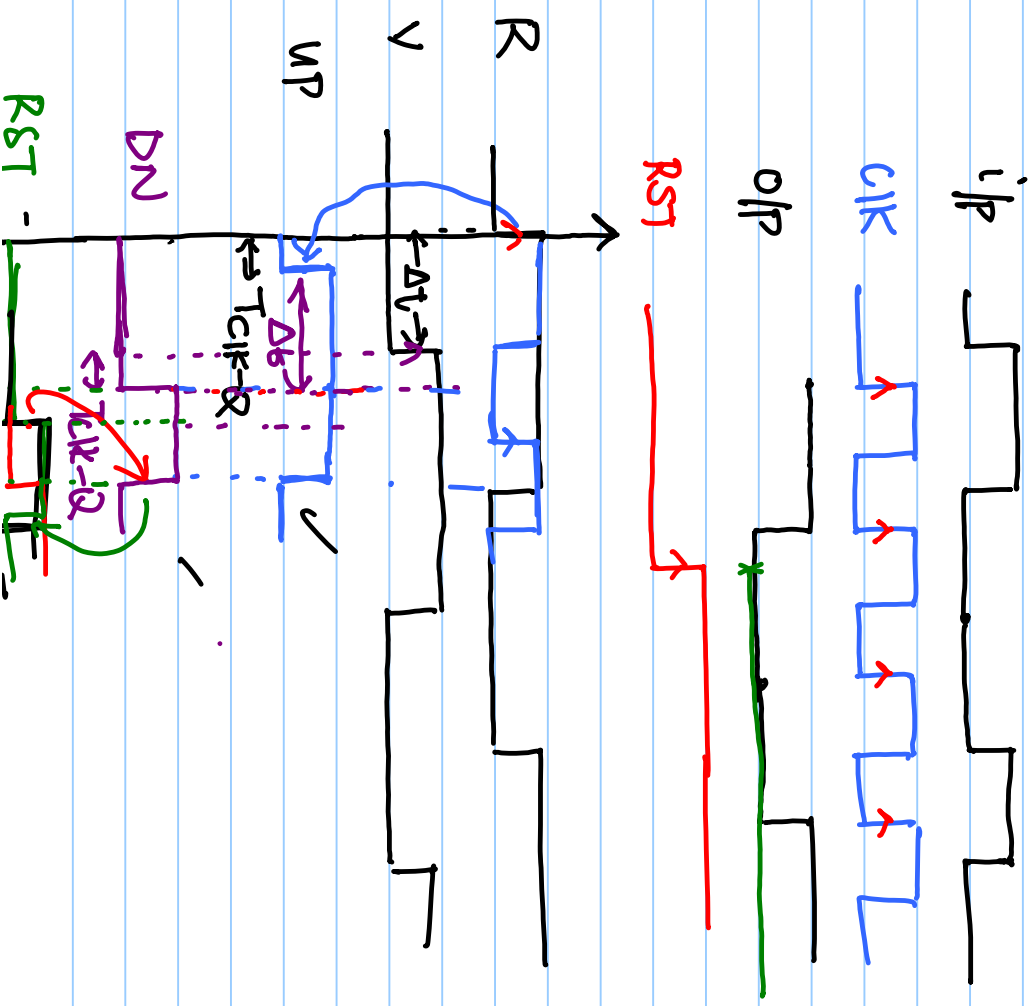
lecture # 34

Phase-frequency Detector (PFD)



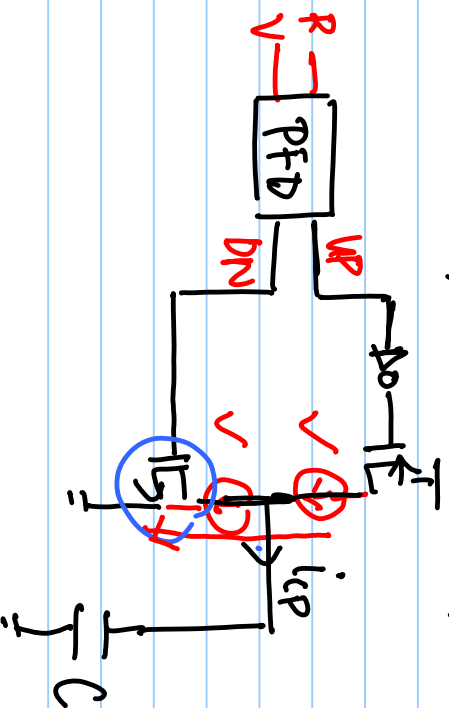
$$t_{up} = \Delta t + T_{rand} + T_{rst-Q} + T_d$$

$$t_{dn} = T_{rand} + T_{rst-Q} + T_d$$

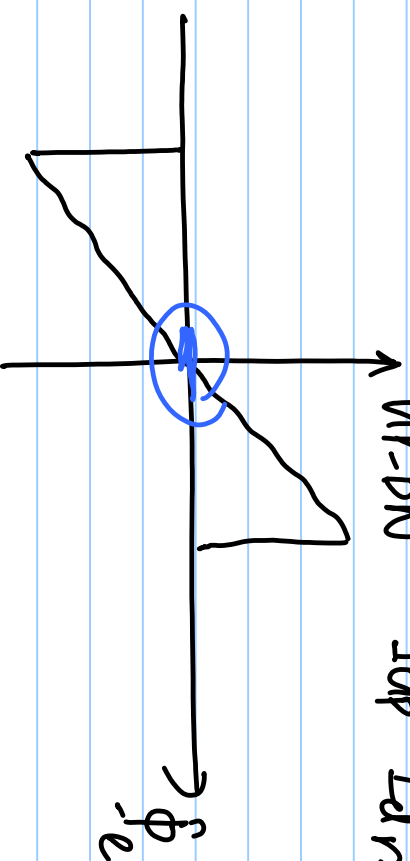
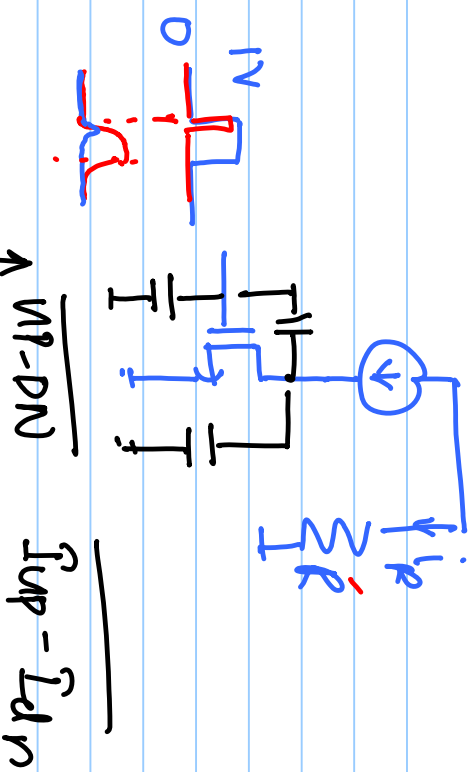
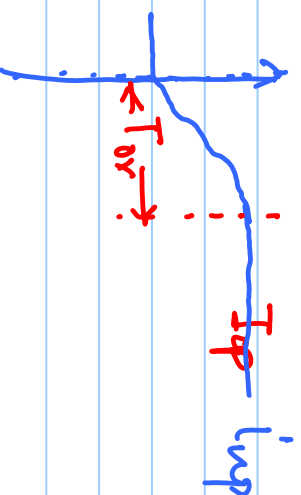


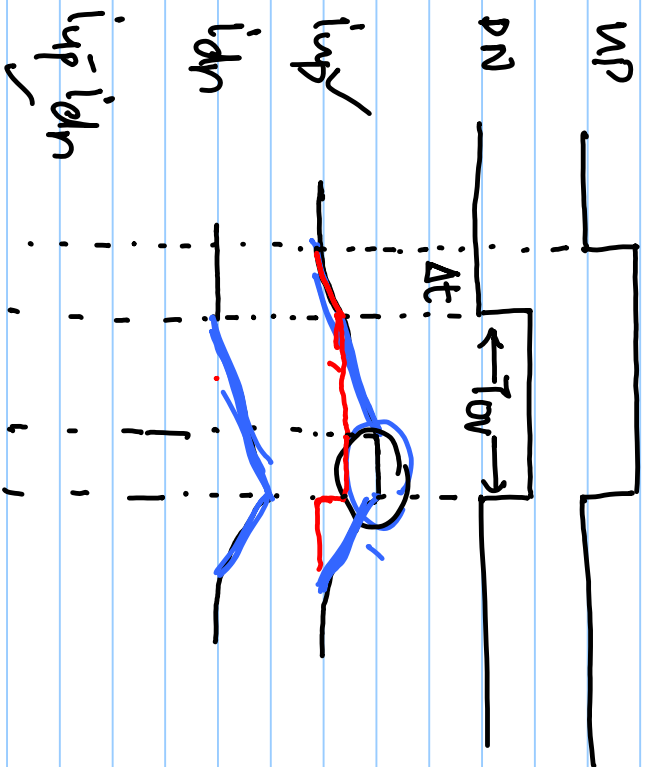
$$t_{up} - t_{dn} = \Delta t$$

if $\Delta t = 0$, $t_{up} - t_{dn} = 0$

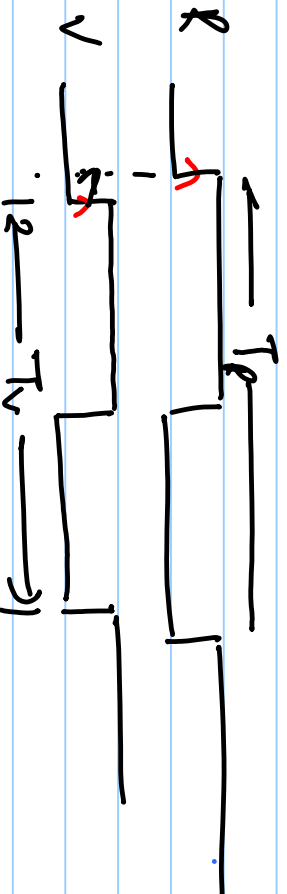


$$\Delta V = \frac{1}{C} \cdot I_{CP} \cdot \Delta t$$

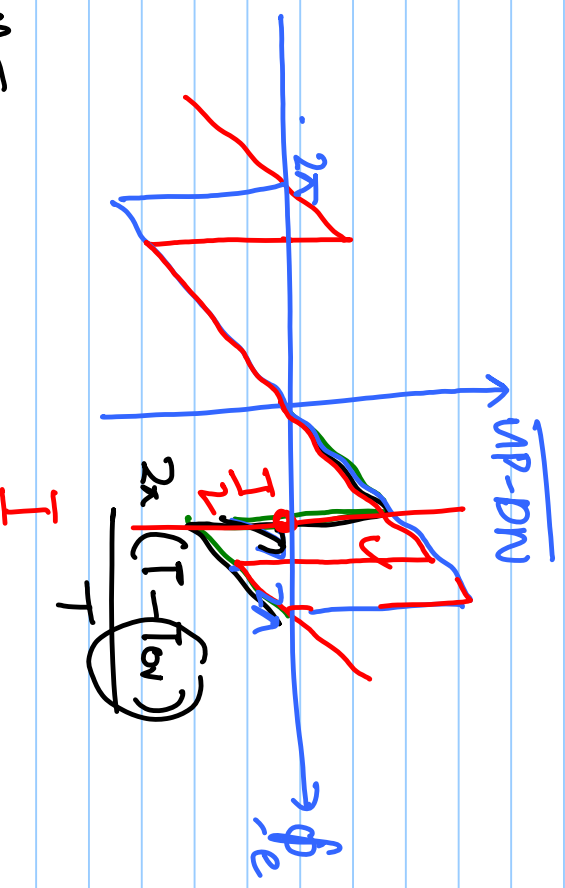
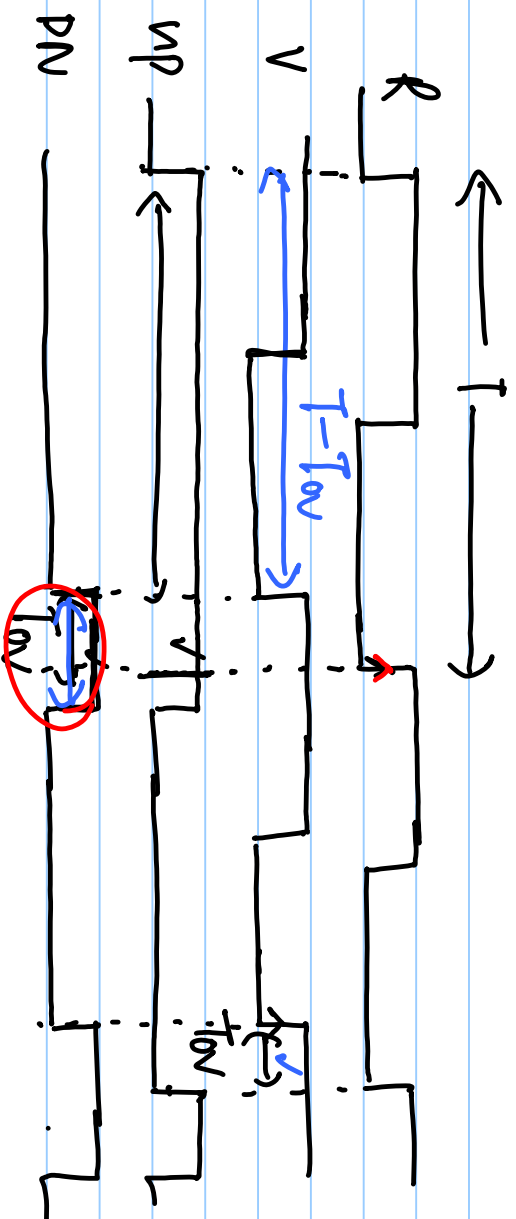




$$T_{ov} = T_{nand} + T_{rst-Q} \checkmark + \bar{C}_d$$



$$N T_R = M T_V$$



$$T_{ov} \leq \frac{T}{2}$$

$$\frac{1}{T} \leq \frac{1}{2T_{ov}}$$

$$\boxed{f_{ref} \leq \frac{1}{2T_{ov}}}$$